SUGGESTIONS ON THE CANAL POLICY OF PENNSYLVANIA

By

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SUGGESTIONS

ON THE

CANAL POLICY OF PENNSYLVANIA,

IN REFERENCE TO THE EFFECTS OF THE

INLAND NAVIGATION of the ADJOINING STATES,

ON THE

COMMERCE OF PHILADELPHIA.

ALSO, IN RELATION TO

A DIRECT CANAL

THROUGH THE COUNTIES OF

CHESTER AND LANCASTER,

TO THE

SUSQUEHANNA;

AND OTHERS THENCE TO THE

OHIO.

WITH FACTS AND COMPUTATIONS RELATIVE TO THE COMMERCE

OF THE

CHESAPEAKE & DELAWARE CANAL.

BY

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CIVIL ENGINEER.

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In the progress of National prosperity the time was to have been expected when the sovereignty of the States would be wisely and effectually directed to the development of the resources of the country; yet the era of Internal Improvements could not well have commenced at an earlier period than the present. The hostilities of Europe afforded to American neutrality an Opportunity of commercial operations too advantageous to be neglected by enterprise or by patriotism, and wealth was rapidly and greatly accumulated, to afford the future means of giving immense value to a fertile interior, and of securing progressive and proportionate aggrandisement to our Atlantic cities.

Experience in older countries has found Canals to be the only mode of economical commercial transportation between the seaports and manufacturing towns—the mining and agricultural districts; they are here, therefore, fast coming into use to equalize the bounties of nature and enable our cities to sustain a profitable intercourse with the commercial world.

The proximity of Baltimore to the Western States gave her an extremely lucrative trade until the navigation of the Mississippi by steam power diminished this resource, which to recover by a Canal, appears to be strongly and rationally recommended as the *true policy of Maryland.*

There has rarely occurred in any country an object for a Canal more important than this in contemplation by Maryland.

Its accomplishment is absolutely essential to the prosperity of her Metropolis.

A law has been passed which gives to this city the privilege of raising the funds by loan, in the least burthensome and most equitable manner: it gives the power not only to check her career of decline, but to restore and enhance the value of property from the moment her resolution shall be taken to achieve the stupendous work of the Baltimore and Pennsylvania Canal. This comparatively limited objecct is alone worthy of her utmost liberality and energy, but it leads to the ultimate source of unbounded commerce: nor will this be her only avenue to the Western States.

It would be a fatal security to rely on any long continuance of the present irresolution of some very opulent men. They are also men of calculation whose patriotic dispositions will be perceived to be seconded by an appreciation of property, that will have paid in advance the whole cost of the Canal. Nor should it be doubted that on every great occasion the natural prejudices which have their origin in the various countries or districts of a country, whence men have come to form an American community, are soon extinguished in national sentiment.

The practical political economy of the State of New-York, with enlightened foresight, is making this facility co extensive with her limits. She is relieving the burthen of her own accommodation, by opening a channel to her Metropolis for the people of *other states, willing tributaries* to her financial and commercial prosperity.

Pennsylvania may not yet be *fully aware* of her commanding position, nor of her natural resources. It remains to be realized with what ease the tide of emigration from the east might be led along her fertile vallies—with what certainty

the trade of the Western States might be made to flow through the direct channels which nature has formed in the middle counties, rather than by the circuitous and precarious course of the Mississippi or the Lakes.

Philadelphia is sometimes said to be without *public spirit*, and that her opulent men are coldly indifferent to the general prosperity. Yet this cannot be a just imputation. There is no absence of a proper degree of regard to the public good in this or in any part of our country. On the contrary it is true that liberality has been too often disappointed by the neglect of due previous investigation. A timid and parsimonious policy may have given cause for a degree of caution, which may impede and prejudice rapid improvements; but whenever confidence is restored by a fair comparison of the means with the end,—the cost with the benefit—so that men of business and sound judgment can apply to an undertaking proposed, whatever its magnitude, the same rules of prudence which govern them in their own more particular concerns; and if the object of investment be worthy of the capital required, there can be no more want of public spirit than there is of money. A speculating rather than a calculating energy has too often given existence to this kind of distrust. A public work, not at first worthy *all* it may cost, should never be undertaken, unless as an avowed offering on the altar of patriotism.

The recent publication of the Report of the gentlemen appointed by the Legislature of Maryland, to investigate the facts relative to her Canal, places the whole Canal subject in a new point of view, and may warrant discussion by all who are habitually attentive to the progress and effects of works of this nature, and who may perceive where and how they may be made eminently subservient to practical political economy.

Pennsylvania has not been without those whose vigilance over her welfare in this respect has been productive of much good: Men of the first intelligence have written and have legislated on this interest of the State, but the time is at hand when she should act effectually. On the one hand the purpose for which a convention was assembled at Washington, on the other the concentrated energy of New-York, contending for the same great object, the Commerce of the West, might well excite the energies of a great and powerful Commonwealth.

It would indeed seem from the whole scope of the Maryland Report, that the apathy of Pennsylvania is calculated upon as well as an incredible indifference to the prosperity of her own Metropolis.

The Commissioners have shewn that although the Canal will cost 2,600,000 dollars, such will be the amount of tonnage that at the lowest computation of the income, it must yield 10 per cent. per annum. For it is well known that one million three hundred thousand dollars worth of produce descends the Susquehanna every spring; a small part of what would descend by a Canal: and that merchandise to the amount of 12 millions of dollars goes westward annually from Baltimore. But Philadelphia is supposed to send 17 millions into the country in the same direction.

The value of the navigation of the Susquehanna has long been known by experience. The following is the description given of it by the Maryland Commissioners.

"We descended from Owego in the state of New-York, to "Harrisburg in Pennsylvania, in the month of June last, when "the stream was perfectly pellucid, and its bottom almost every "where distinctly visible, From Owego to Nanticoke Falls, "(130 miles) there is no ripple. Its waters glide smoothly

"along, often quite sluggishly, and sometimes with a rapidly "accelerated motion over gravelly, stony, or rocky bottom, but "no where tumbling like a torrent."

The Commissioners then go on to describe the successive rapids that occur in the remaining distance to York Haven, not one of which they say, is attended with any difficulty or danger in ascending, or in descending. And they add the important facts that

"From every information we have been able to obtain, the "navigation of the Tioga branch from Bath; and of the *western* "branch for a distance of one hundred and sixty miles above "Northumberland, is equally good and very similar in its gener- "al character. The Juniatta, from Frankstown on the north "branch, and from Bedford on the Raystown branch, is report- "ed to be much better, and less broken by falls and rapids."

And

"Taking all the several branches of the Susquehanna togeth- "er, we consider ourselves as perfectly within bounds, when "we affirm that this great river affords a good and safe descend- "ing navigation to an extent of more than *eight hundred miles* "above the Conewago Falls. The ascending navigation may be "reckoned as not far short in extent of that of the descending."

And again—

"It is a well known fact that no produce is sent down to "market by land, from any part of the country accessible to "any of the navigable branches of the Susquehanna.

"All merchandise is sent from the sea-port (chiefly Philadel- "phia) by land to Columbia and Harrisburg, and thence upward "in boats—"

"In short, for all the purposes of commercial intercourse with "the Susquehanna country, so far as the waters of the river can "be navigated, the whole business moves on it, as well upward "as downward."

Pennsylvania has an interest also in the Maryland Canal unless a shorter route to and from her metropolis can be found and opened; for it is well understood that wherever the commercial market is great. the competition among the merchants is favourable to the agriculturist; and he knows that whatever sum is saved by water carriage, is added to the value of the article conveyed.

It is then at the mouth of the Susquehanna, where the business must divide, that the facility of Canal Navigation, together with the attraction of mills, markets, and capital, will decide what share each Metropolis shall have in the outward trade.

A comparison of the time and expense of the Bay passage and Canal passage, made in the Report, appears to be conconclusive:

BY THE CANAL.	BY THE BAY.
Distance 40 miles.	Distance 70 miles.
Delay and passage 2 days.	Delay and transhipment 8 days.
Freight and Toll on 40 tons of Coal, Grain and Flour, 21 dollars.	Freight on 40 tons of Coal, - - $45 40 tons of Grain, - - 52 40 tons of Flour, - - 38

And the Commissioners justly remark—"These advantages "are perfectly obvious and decisive; and from this statement "it is also clear that with this continuation of the proposed "Canal from Port Deposit, no other market whatever, can, "with any thing like the same advantages, come in competition "with that of Baltimore—because, to reach any other sea-port "would require *transhipment* at Port Deposit, additional tolls, "exposures, delays, and the travelling a *much greater* distance "by Canal and natural navigation."

"The Canal thence to Baltimore would open and afford a "most inviting, convenient, and safe mode of being transported "*dirrctly* and expeditiously to the city, and from which it is "confidently believed no *river vessel* would willingly turn "away for any other market whatever."

The Commissioners also state that by attempting the Bay with arks, *so many losses have occurred,* that it is equally customary and necessary to tranship all the loading into vessels.

Experience is equally conclusive in regard to the business across as down the Bay. For to enter Elk River, *Turkey Point must be doubled,* and a boisterous tide encountered for *fifteen* miles, *seven* miles broad and by a kind of vessel not adapted thereto, nor equipped for sailing. Therefore *all must go to Baltimore,* unless *a canal* offers them *equal* accommodation in the opposite direction.

These facts suggest the desirable continuity of the Delaware and Chesapeake Canal to this point, founded on the evident economy of preventing a transhipment of produce. The distance is about 16 miles, and the ground is thought by those who have traversed it to be favourable, and the water at command abundant. The expense can only be computed on ascertained facts, but as it will not interfere with many mills, and will be principally for arks, it is highly probable it may be done for 200,000 dollars. Arks and boats might then have the advantage of arriving in the waters of the Delaware in about 30 miles of Canal, in the vicinity of at least 40 mills, 60 factories, and a population of 30,000, and at an easy distance from Philadelphia by tide water, so that it is highly probable the time and expense of reaching this city, would not be greater than to reach to Baltimore 40 miles by Canal, especially if steam boats are employed to impel them.

The most southern location of the Chesapeake and Delaware Canal will affect the public economy favourably or unfavourably, as the expense may allow of moderate tolls; and its construction admit a more or less convenient access from the two Bays. The high standing of the gentlemen to whom the question of its location was submitted, precludes every

doubt of their acting upon the *given premises* with the utmost caution, integrity and ability. Nor can it be supposed that those to whom the proprietors have committed the care and direction of their interests, could have any other wish and aim than to fulfil faithfully their great trust.

It is therefore a task of some delicacy, independently of the personal consideration and respect entertained towards all those gentlemen, to assert the existence of *new relations* to the subject that may not have struck them: or even that they may not have anticipated the effects of the energy and enterprise of Baltimore, of late made evident by the publication of the Maryland Commissioners' Report to the Legislature.

The real importance to Philadelphia of a Canal between the Bays, effectually to counterbalance that enterprise, is the immediate motive for the statement of facts relating to its productiveness—which will appear in a few of the subsequent pages, deeming it proper to trust in the well known candour and liberality of those gentlemen—even should a *new view* of this ground not meet with the concurrence of their judgement.

There are unquestionably two views to be taken, one contemplating and including the national accommodation—the other merely *commercial facility.*

By the result of the consultation it appears that the former plan was preferred, and the dimensions of the work calculated to afford a passage to vessels of 8 feet draft—and steam passage boats of the usual construction—and ultimately to ships of the navy.

This determination presupposes the existence of an amount of trade and passage between the bays to warrant the increas-

ed expense of this plan, or trusting that the difference in the amount of cost might be provided for by Congress.

The great exertions made, and well known to the public, to induce subscriptions in the city of Philadelphia to the amount required for a Commercial Canal, seems to admit the conclusion that Congress is relied on for the remainder; as *loans* can rarely be effected on property of this kind before it has acquired value from the certainty of its completion and income.

If it were really of National importance that such a passage should exist for the accommodation of the Navy, there should have been already a liberal appropriation tothe expense, and the private stockholders allowed not only a preference of dividends, but if the income were deficient, the deficiency made up from the treasury, as if they were public creditors.

But in fact the plan of this broad and deep passage for the Navy appears to have been given up by an indefinite postponement, and the dimensions reduced to a conformity with the usual size of coasting vessels. If therefore the question were merely, Where a Canal for vessels of eight ft. dratt should be located, independently of the expense—and with reference to a deeper passage at a future day? the board of engineers must have decided judiciously, the supply of water being ascertained we presume by measurement.

The two plans alluded to, of a merely Commercial Canal, on the one hand, and a magnificent undertaking worthy of national patronage on the other, have, it appears, divided opinion: and produced an alarming degree of distrust, and doubts of ultimate successs, evident from the value set upon the stock at a late public sale

If therefore those doubts should become so prevalent as to prevent the execution of the bolder plan, it may be not without use to spread before the proprietors and the community, those considerations which should induce them to persevere in having a canal adequate to mercantile accommodation and adapted to the competition to which we have alluded.

That a Canal between the bays would be useful in times of hostility, for the conveyance of munitions of war, is unquestionably true: but it is also obviously so, that vessels of 50 or 60 tons will carry any thing of this kind. And if it is of consequence that such a communication should not be interrupted by any hostile irruption upon the coast of either Bay, it must be more safe near a dense population.

If the continuity of the water passage for travellers is a desirable improvement, there are two ways of attaining it—either by adapting the Steam Boats to the Canal, instead of the Canal to the Steam Boats, at great increase of expense, together with delay and inconvenience to other vessels—or by transferring the passengers to a Canal Packet drawn by horses.

If nothing had been done decisively to fix the location of this Canal, or if from any cause the question were returned to its original ground, then what the French writers on canaling call their *régime* or test of propriety and expediency, might be applied in this csse, as Canals are generally made on calculation of profit. On this principle the facts subsequently stated would be considered as some guide.

In the year 1810 it was thought, as at present, desirable to interest the national government to take part in this work. On request of Mr. Bayard of Delaware, then in Congress, inquiry was made by a mercantile gentleman of Philadelphia,

into the actual amount of tonnage carried between this city, and Baltimore, Norfolk, Petersburg, Richmond, Fredericksburg, Alexandria, and Georgetown ; and it was found from examination of the Custom House Books that there were 188 arrivals and 191 clearances, of which the average did not exceed 80 tons—and the return freights were generally small, and not exceeding half loads. The aggregate tonnage therefore was 19,680 tons; including certain specific articles, as 4,200 hogsheads of Tobacco, 140 tons of Hemp, 1000 bales of Cotton, 1296 barrels of Naval Stores, and 100,000 bushels of Coal, 50,000 bushels of Wheat, 10,000 barrels of Flour, together 7,780 tons. The rest being in various merchandise.

Coal which has always made an important item in the estimated importance of this Canal ever since the official report of Mr. Gallatin, will, in future, come from the opposite direction to the city.

In the following estimate we shall fall short of that by Mr. Gilpin in his able memoir on the subject of a Chesapeake and Delaware Canal, but as his data are assumed, if the conclusion should be that this is too low, and the truth intermediate, the test of the *propriety, or rule of expense, warrantable for the Canal* will not be essentially affected.

In the year 1823 we find by the accurate list of arrivals and departures k' pt at the Coffee House, that there were

From Norfolk,	21
Petersburg,	18
Richmond,	40
Baltimore,	24
Alexandria,	7
Fredericksburg,	2
	122

122 arrivals at 80 tons is 9750

The clearances were—For Norfolk, 33
For Petersburg, - - 6
For Richmond, - 15
For Baltimore, - - 30
For Alexandria, - 10
For Fredericksburg, - 4

98, at 40 tons or half loads..3920

The trade to and from Baltimore over land, it is said, by those who are competent to the opinion, did not exceed..... 3000

Produce from Susquehanna, over land, is estimated at 1000

The number of arks which descended that river the last year was 537, as appears by a Register kept of them at Port Deposit; and supposing half to come to the Delaware—268 at 40 tons,..... 10,720

28,390

Thus it appears that twenty-eight thousand tons is all that can be reasonably expected to pass at present the Chesapeake and Delaware Canal, even admitting that vessels from Norfolk, James River, and the Potomack will not *sometimes*, if the wind favors, come thence by the coast.

In the months of August and September, the average to and from all those cities, was but one vessel to two days.

The Tobacco trade which amounted to 3200 hogsheads in 1810, was the last year, reduced to less than 500, owing to the preference of Kentucky Tobacco, which suits the manufacturers better, at its price, while that of Virginia suits

the English market best. We can confidently appeal in this matter to the dealers in the article.

The remarkable difference between the number of arrivals and clearances is owing, in some measure, to the trade with New York, which freights these vessels thither— whence they load for the Chesapeake. It is a well known fact that the trade of Philadelphia with New York, is much greater than with the ports of the Chesapeake.

New York has two or three times as much trade with the cities on the Chesapeake as Philadelphia enjoys ; and how far it would be reasonable to calculate and rely on diverting this commerce, is very questionable. It will depend upon the best market for Tobacco, Flour and Grain: or if a part should be diverted, it may be generally balanced by the number of vessels (included in our estimate) which entering the Bay, near its southern extremity, would half the time, have fair winds along the coast. Coasting vessels, therefore, ought not to be relied on somuch as those of a very easy draft of water, equally adapted to the Canal and the shallow waters of all the rivers, and which may also go through the Canal to Albermarle and Pamtico Sounds, which embrace the coast of Virginia and North Carolina. This class of vessels sail at less expense than those that are equipt for sea, and can afford to carry at a lower freight. At present New York has a share of the produce sold at Port Deposit, and shipped by the Bay ; but if a Canal led from that place the whole distance to the Delaware, then, as no transhipment would be required, it is reasonable to suppose the produce would reach a better market without delay at the expense of a moderate toll, which the difference of price would amply afford. A large and deep Canal would allow *light*

vessels to go from New York to Port Deposit direct—returning home loaded by the Bay and Coast.

Pursuing the inquiry therefore into the commercial expediency as a rule that should govern the expense of this Canal, it will even appear that Mr. Strickland's plan and estimate of the upper route, is on too large a scale for the existing or prospective trade. We understand his estimate is founded on the dimensions of 60 feet wide by 10 feet deep. Locks 20 feet wide, 80 feet long—and an artificial Reservoir of 40 acres. The estimate including Feeders, purchases and compensations, amounting to 983,884 dollars—yet admitting of deductions, if the waters of the Elk alone are used, which reduce it to 761,545 dollars.

Persuaded that this gentleman will excuse the liberty of these remarks, as neither the writer of them or himself, can have any interest so strong as the success of every public work of this kind, founded in a just conception of the objects of them, and the expense they will warrant; for it would be a great discouragement of internal improvements, and therefore a public misfortune, if the next Canal in the United States should prove bad property: it may be said that this work ought rather to conform to the Virginia Canal, and to the probable dimensions of one, at no very distant day, through New Jersey. The size of the Erie and Champlain Canals, do, in fact, permit the passage of vessels of 60 tons, capable of navigating the Lakes, at times, more boisterous than the Chesapeake. It is also a fact, that one class of the Canal Boats in England navigate the Harbours and Bays, having a hinged mast and slide keels like the flat sloops of New York. Therefore a Canal of this size would actually answer the purpose, if that purpose be essentially a commercial one.

The question of a sufficiency of water becomes essentially varied by the change of the dimensions of the Canal and the Locks. If inadequate to a Canal of the largest size, it may not be so for one of a sufficient size.

It is well known to the public, that two gentlemen highly competent to the inquiry were appointed to measure the waters of the Elk and White Clay Rivers at a time when the season was extremely dry. They ascertained to their satisfaction that the Elk discharged 41,700 cubic yards in 24 hours, and White Clay Creek 46300 cubic yards. A lock of the size of those of Erie Canal requires 400 cubic yards. Therefore after allowing one fifth for evaporation and soakage, the Elk alone would supply enough in the dryest season for 80 locks a day.

But it will be still more satisfactory to calculate from the premises given in the annexed letter of the owner of Elk Forge:

He states the head of water to be five feet. That he uses
3 gates 3 inches by 3 feet, 15 hours.
2 gates 10 inches by 3 feet, 7 hours.

The velocity of the water under that head being 17,88 ft. per second—a deduction (in practice) must be made in the velocity at vena contracta of 1-4th, which is 4,47

Actual velocity at the orifice, ... 13,41 ft.

Therefore the 3 gates deliver in 15 hours .... 1,629,315 ft.
The 2 gates deliver in 7 hours 1,702,260

Cubic feet, ... 3,331,575

Equal to cubic yards,..... 123,391

Brought over, ...	123,391
Allow and deduct an average loss in 3 dry months of 3 weeks equal to 1-4th of this period,	30,848
Cubic yards....	92,543
Allow and deduct also for evaporation, beyond the fall of rain and for soakage 1-5th	18,508
There remains in the most unfavourable view as the average of the three dry months, Cubic yards, per day, ...	74,035

Size of Lock $90 \times 15 \times 8 = 400$ cubic yards gives 185 Locks per day.

If the Canal has 16 locks, viz. 8 from the summit each way, the number of Locks full per boat, would depend on the continuity or frequency of passage. If they were in sufficient number to take advantage of each filling, so that one should go down as the other came up, one lock full would serve two boats—so in the other extreme, if one boat alone were to pass, in ascending, she would use 8 locks full, and in descending 1 lock full. Therefore, to allow each boat 4 locks may be the proper average, viz. 46 boats per day.

A boat 80 by 14 drawing 4 feet, will carry between 70 and 80 tons, if flat, making due allowances for the shape of the bow and stern ; calling the average burthen 60 tons, the amount per diem is 2760—and for 260 days 790,000 tons.

To this quantity of water a reservoir of 50 acres would superadd, if 12 feet deep, 968,000 yard—which divided among 90 days of dry season is 26 locks per day, and would give about 7 boats per day or 420 tons. Other Reservoirs might be constituted of the Mill Ponds under proper regulations.

We have aimed to exhibit the least favourable view of this

subject; and have not included White Clay Creek, which Dr. Patterson and Mr. Lukins found to yield 46,000 cubic yards in 24 hours; equal to as much more business as described, presuming all proper precaution taken to have a tight Canal and feeder.

After a Canal is made it is to be managed and kept in order. This expense is chargeable to the income. If a heavy charge it diminishes the value of the investment. It is not the attendance of a few locks more or less that is so material as the keeping the Canal clear. Canals are subject to abrasions and irruptions. Frost as well as rain, loosen and carry in earth from the slopes. This liability is in proportion to the surface exposed. No precaution, even where the deep cutting is but 20 feet, can prevent a constantly recurring occasion of expense. What this would be in a cut 30 to 70 feet deep for three or four miles, it must have been deemed equally impossible to calculate as to prevent. Time is the most material point of comparison between routes. If 16 Locks require one hour more than two, but the route on which there are two is as much farther as to take one hour, they are equal. If the expense of attending 14 locks should be 1000 dollars more annually on the one, and the exposure to reparations on the other be equal to this sum, the routes are equal. But if the unfavorable contingencies and requisite capital in one, is greater than the other, the amount of business the same, the least expensive and the least exposed must be most economical, preferable and profitable. If *the freight* at present from Christiana Bridge to which vessels go drawing 7 feet is no more nor so much as from St. George's, and a Canal can be had thence to the Chesapeake at least expense, the commerce is the less burthened and the stockholders more profited. If the route from Christiana has the peculiar advantage of an adaptation to the present state of commerce, with a capability of enlargement, should its increase ever require it, it would seem to be the safest operation. When this shall be found to be the case, then would be the time to awaken farther exertions of public spirit on the only proper basis of it, when applied to Canals, *calculation of profits.*

It is stated that in some six months of the last war, one house in Philadelphia paid 60,000 dollars for "Inland Transportation" and that six times this sum might have been paid by others. The cost of land carriage was, we know, in the last war, as high from Virginia and the Carolinas as 123 dollars a ton. At this rate $60,000 paid for only 487 tons, and six times that sum for 2722 tons. Whatever argument this fact affords for peace, it does not prove commerce to exist worthy of a Canal that must cost one and an half million. In peace the *cheapest* conveyance will be employed, whether by Canal Boats or Coasters. In time of war the *safest*. There is no point of comparison between the Chesapeake and Delaware Canal, and that of Erie, which leads to a region *inaccessible by water* in any other way.

The trade of Philadelphia with the interior is of far more value than that we have been considering. It is in fact the same which New York is aiming to secure by a Canal of great extent and expense—it is the same that is deemed worthy of a National Canal from Washington to the Western Waters—and the same (together with the trade of the interior of Pennsylvania) which the city of Baltimore is aiming to draw to herself. An extract of General Harper's late eloquent speech at the meeting of the city of Baltimore on the Baltimore and Susquehanna Canal will be annexed.

The Commissioners estimate the immediate business at 250,000 to 300,000 tons, but confidently expect it will soon be three times this amount.

The exportation of produce will take those channels of commerce which the season and the markets will prescribe, as well as the facility of passage invite. In the winter and early spring the Mississippi is descended with more expedition and safety; in the summer and autumn a middle route will be preferable. Nor should it be overlooked that there is a great extent of fertile country filling up with people, much nearer to New Orleans than Ohio, Kentucky, Indiana and Illinois, which will soon interfere with those states in the sale of their products; and supply also to the north and the east those arti-

cles which the manufactories likely to be every where established in the middle states will require. Cotton, Hemp, Wool, Wheat and Flour, it is probable, will be principal articles of transport from west to east, as well as the products of the manufacturing industry of Ohio.

It will be recollected what quantities of Hemp were at one time brought to our sea ports from Kentucky, not only in its raw state but manufactured. It was not inferior to that of Russia for any commercial purpose. Why the culture of this very important article was allowed to cease is inexplicable.—Whenever it is resumed, which it must be at no distant period, the western counties of Pennsylvania, and the Western States, will give this article in return for foreign supplies. Iron is one of the most essential articles of domestic commerce and manufacture. It is imported to the amount of three millions of dollars a year from Europe: yet it exists in the centre of Pennsylvania in contact with vast bodies of Coal. Water carriage and due protection by government will make this a mine of wealth to the country.

It would be easy, were this the proper occasion, to demonstrate the importance and sufficiency of the object for a direct and complete inland navigation to Pittsburg, and, combined with the business of the intermediate country, its great sufficiency to reward the investment. But the principal purpose of these few pages is to awaken attention to the *disadvantages* which must ensue to Philadelphia on the accomplishment of the Baltimore Canal, and to suggest the means of counterbalancing those effects.

From York Haven to Baltimore will be 93 miles of good descending canal navigation—and from the same point on the Susquehanna by Union Canal and the Schuylkill Navigation to Philadelphia, the distance is 136 miles of ascending and descending canal navigation.

Believing that the Schuylkill and Union Canals will have as much business as they can do from the *coal trade* and the well cultivated counties to which they lead, it will be no dis-

paragement to demonstrate that they are not equal to the whole trade of Pennsylvania, and therefore not a counterpoise to the Baltimore Canal.

The question How much tonnage the Schuylkill navigation can give passage to, as now constructed, admitting there will be always an abundance of water? may be answered by taking the least favourable part of it as a *guage* of its capacity for business, viz. where there are four connected locks. Supposing therefore that a boat arrives at the upper one, at the moment another arrives at the lower one, it takes 20 minutes for the first to descend, and 20 minutes for the last to ascend; and if they are loaded with 30 tons each, 90 tons will pass in one hour—2160 in 24, and 540,000 in 250 days, working night and day incessantly. One half as much more might be done if boats always arrived in pairs.

Allowing one half to be downward loading 270,000—if half of this is coal 135,000 tons (the quantity Philadelphia alone will require) it leaves 135,000 for other productions, from the vicinity of the Schuylkill and by the Union Canal.

The descending trade will be far more bulky than the ascending, and the return boats may be but partially loaded.—The accommodation in question must be adequate to the downward trade; and we must therefore doubt the capacity of the Union and Scuylkill Canals for the internal commerce of Philadelphia, when the Susquehanna shall be connected with the Ohio. If not adequate to the local trade of the counties through which they pass, and to the Western Trade, it is worthy of inquiry, Whether the local trade of Chester, Lancaster and York, especially if the Iron of these counties should be made in greater quantities, may not require a Canal, which will at the same time, aid in the intercourse between the west and the east.

Ascending the Schuylkill to the Chester Valley—opposite Norristown, there presents a direct route to Lancaster and Columbia, *forty miles nearer* than by Lebanon, viz. ninety-six

miles, or an equal distance from Philadelphia as to Baltimore from York Haven.

As early as 1773 a Committee of the then Provincial assembly was sent to explore the ground through Chester and Lancaster counties. The late Dr. Rittenhouse, and late Mr. Lukins, were selected as men of science, to perform this service; and they reported, as their opinion, that a Canal might be made through these vallies, passing the mountains by the Gap, so called and well known, which summit is commanded by neighboring streams. The same Committee also examined the ground between the Tulpahocken and Swatara rivers (the present site of the Union Canal) and reported this also to be practicable.

It is well known that the war of the Revolution suspended public works throughout the country ; but subsequently the prospects of America were so bright as to awaken a spirit of active enterprise. The interior was every where explored, and a number of intelligent citizens of Philadelphia, began this navigation, perhaps prematurely. The Union Canal was also then projected and commenced. The Schuylkill led to the then most populous parts of the state ; and a Canal connecting it with the Susquehanna, was reasonably expected to bring accessions of business. This location must have been preferred to the Chester county route as interfering less with mill privileges. The work was however suspended, and lay dormant till the discovery, if not of the *Coal* itself, yet of its great value, gave a new impulse to both enterprises.

The *direct* route through Chester and Lancaster, ascertained by Dr. Rittenhouse and Mr. Lukins to be practicable, has now lately been verified by Mr. Haines, the official surveyor of the city of Philadelphia, whose capacity and intelligence is well known. And the public cannot but view the providen-

tial existence of this opening in the range of hills in so direct a course to the Susquehanna, as a strong indication of the true canal policy of Pennsylvania.

It appears that there is no obstacle of any formidable magnitude; none that demands uncommon expenditure, and but a small number of aqueducts are required in proportion to the length of the way, though some must be high.

The distance are thus compared :—

The Schuylkill navigation to Reading, ...	58	
By the Union Canal, ...	78	
	136	miles
Up the Schuylkill, ...	16	miles
Through Lancaster and Chester, ...	64	
Up the Susquehanna to the mouth of Swatara, or Union Canal, ...	16	
	96	miles

The waters commanding the Gap or summit land on this route, are probably equal to the supply of locks of the common construction. But the interference with mills would be a serious impediment, and we are glad to believe this difficulty in a great measure obviated by employing the method of locking (more economical of water,) described in the February number of the American Journal of Arts and Sciences, translated from *Les Annales de Chimie*—a demonstration by M. Girard, of his theory that water may not only be saved, but raised to the summit level of a Canal, by making the lift of the the locks less than the draft of the descending boats. This method is in theory well founded, but loss of time will attend it in practice. Yet this circumstance will be immaterial compared with the saving of water to mills.

Another method of saving water may be resorted to it is believed with confidence. A description is annexed of a lift, the invention of Mr. Benjamin Dearborn of Boston, whose long life has been devoted to mathematical and mechanical studies and inventions; and no one has been more successful in this line of usefulness.

By forming reservoirs while the waters are copious in the spring, the Canal will be supplied without disturbing many of the mills, and these only the highest on the stream.

We give a brief description of the route of this Canal thro' Chester and Lancaster, as it will probably be made.

The Schuylkill being ascended *sixteen miles*, by the present locks, or preferably by a Canal on the west shore of the river, the elevation gained is 50 feet; thence the Chester Valley gradually ascends for ten miles, watered by Valley Forge Creek to the elevation of 271 feet above Schuylkill, which distance would be divided into three, four, or five levels or pounds as might be found expedient; and according to the system adopted whether of Locks or Lifts.

Near the head of the Creek is a sudden rise of ground of 32 feet, which separates this from the next division of the valley, along which another stream runs in the opposite direction. By cutting this gravelly ridge 40 feet deep, at a base of 200 rods, the levels of the two vallies will be connected and prolonged westward for eleven miles, in favorable ground, to within three miles of Coatsville, crossing the east branch of the Brandywine by an Aqueduct.

At the western end of the last mentioned level, the ground rises suddenly, and affords on this declivity a favourable situation for the next ascent. The Ridge may, however require

to be somewhat reduced for 100 rods to conform to the ground beyond westward. This level crossing the west branch of the Brandywine will be 162 feet above the last, and extend a little west of Park's Tavern : one mile from which, (west) we attain ground which begins the *summit level* four miles east of the Gap.

Hence the summit level may extend along the northern slope of the valley, to within 75 rods of the highest point of the Gap, through which it may be continued by a cut whose base shall be 150 rods, and greatest depth 40 feet. The summit level being 490 feet above the Schuylkill.

From the western termination of the summit level the ground descends 70 feet in about one mile, within which the Locks or Lifts required must be placed.

From this position we have a choice of uncommonly favorable ground the whole distance to the Susquehanna, the descent to which is 245 feet. And the most eligible course of this canal will pass close enough to the city of Lancaster to form a Basin for the accommodation of business.

The supply of water for the levels through Redyffrin, and East and West Whiteland may be drawn partly or wholly from the two Valley Creeks- The Eastcaln level may be supplied from Beaver Creek and the West Brandywine ; and the Sadbury level from Buck run. The summit level by a Feeder from the west branch a little below Beaver Dam, at the eastern extremity of the township of Honeybrook ; from which point (ascertained to be as high as the Gap) the feeder may be led along favourable ground, and probably by a shorter course into Buck Run, on which we also rely for this portion of the supply water. On both these streams Reservoirs may be formed, as well as on the two branches of Octorara

Creek which here cross the line of the Canal. In Lancaster county, the head waters of the Pequa will afford a Reservoir and Feeder which in its course may receive several brooks from the hills, led near Passmore's saw mill. The probable course of the Canal will then permit of taking in Eschelman's run; and after crossing the Pequa, a branch from the main Canal may be extended to strike Mill Creek near Muddy Run, so as to command water enough for the remainder of the distance. But still after crossing the Big Conestoga near Lancaster, feeders may be made to bring in the upper part of Little Conestoga and West Conestoga.

The Canal would necessarily reach the Susquehanna about a mile below Columbia; and the boats would either ascend the river, already practicable—or enter the Baltimore Canal by a lock opposite Columbia and follow it to York Haven and so on to Harrisburg.

It cannot of course be known what a Canal would cost through Chester and Lancaster, without a due and thorough investigation of every circumstance. But for the present, the results of experience may be some guide in this matter.—It is worse than useless, it is delusive to estimate works of this nature at a flattering rate. The consequent disappointment depresses the value of the stock to an unreasonable degree, and delays its completion, on which the value of a Canal depends. There are always hidden causes of expense which reveal themselves as the work advances; while seasons and climate have too their influences.

By a careful analysis of the expense of Middlesex for the use of the Commissioners of Erie Canal, some years ago, it was found to have cost about 17,000 dollars a mile.

By ascertaining the average cost of the list of Canals in England given in Mr. Shriver's late publication, viz. sixty-

three Canals, together 2054 miles, expense $36,621,293, the average is 17,830 dollars per mile. This of course includes their tunnels. But generally, the ground in England is very favourable for Canals, but the compensation for land high.—Erie being on a large scale is expected to cost from 25 to 30,000 dollars a mile. The Schuylkill navigation being a series of Canals will have cost from 15 to 17 thousand.—The extraordinary undertaking now in hand from the Delaware to the Chesapeake it is supposed will cost above 100,000 dollars per mile. The route through Chester and Lancaster is certainly free from many of the formidable difficulties overcome in Middlesex; and as modern improvements, and a very fair aspect of country permit the conclusion, it may not be presumptuous to say it will not exceed 15,000 per mile, or one million of dollars. A canal route from the head of the Juniatta to the Conemaugh, for perhaps 30 miles, is yet to be explored—and from the head of the West Branch also. The latter is free from the greatest obstacle and cause of expense which attends the proposed Chesapeake and Ohio Canal, as the West Branch is the only river that breaks down the barrier of the Alleghany: rising west of the great back-bone range, among the gentle hills which are at the head waters of the Mahoning.

It is probably a liberal allowance for this part of the work to place it at another million, which is done with some confidence from much inquiry of persons residing in that part of the country, into the nature of the ground. Let us then compare this with the great Potomac and Ohio, without disparaging its importance.

From Baltimore to the Monongahela is about 330 miles, and at the same rate as the cost of Erie, 25,000 dollars,

amounts to 8,250,000 dollars. No doubt this great work will be worth all it will cost. Indeed in the late debates at the meeting of the city of Baltimore, General Harper appears to have admitted its probable expense to be 10 millions; and General Winchester expressed the opinion that it would cost 14 millions, and under this impression offered those resolutions which expressed a preference of the Susquehanna route according to the Commissioners' Report, which were adopted by a large majority of the citizens.*

As the point is, By what route the most economical communication can be made? presuming the tolls must be in proportion to the expense, it is obvious that the Pennsylvania Canals will have a decided advantage over the Maryland and Virginia: and Philadelphia over Baltimore. From the same point on the Susquehanna it must cost three times as much to go to Baltimore as to Philadelphia; and four or five times as much to go from Pittsburg to Washington and Baltimore as from Pittsburg to Philadelphia by water.

The objection to natural navigation or the ascent of rivers is obviated by the use of steam power; and a river is of course free from those accidental interruptions which attend Canals. If they are gentle they may be improved and availed of—if deep and rapid they may be stemmed—if shallow they must supply water for Canals.

This Central Canal would lead through some and towards others of the most populous counties of the state: York, Adams, Franklin, Cumberland and Dauphin the seat of Government; thence to ascend the three great branches of the natural navigation. The Juniatta, as appears by a report of a Committee of the Legislature in the year 1793, is navigable for boats of considerable burthen, quite to the head of its two branches; whence, it was their opinion, that Canals

* See appendix.

might be made to the fork of the river Conemaugh ; a branch of the Kiskiminitas, entering the Alleghany *twenty-nine* miles above Pittsburg.

The whole distance may be thus estimated :

From Philadelphia to Norristown, ...	16 miles
Thence to Columbia 64, perhaps	65
Up Susquehanna to the Juniatta, about	30
Up the Juniatta, ...	128
The Alleghany passage, ...	14
Down the Kiskiminitas, ...	87
Down the Alleghany, ...	29
Total, ...	369

Of which 110 miles will pay tolls, and 259 miles be free. And from inquiry, it is extremely probable that another and more practicable route may be found from near Clearfield at the head of the *west branch,* to the Mahoning: the distance somewhat increased.

Freight from New York might after ascending Erie Canal to Montezuma, pass into Seneca Lake, and thence by a Canal rising 434 feet, and descending 57 feet, pass through it 18 miles into the Susquehanna ; descend it to the Juniatta or the West Branch, and reach Pittsburg by the Conemaugh or the Mahoning in 891 miles. One hundred miles further indeed than by Lake Erie, but to descend a gentle river free of tolls and danger one hundred miles further, may be considered an easy offset to a transhipment at Buffalo, the encounter of the autumnal gales of the Lake—transferrence to land carriage or to Canal Boats to reach Pittsburg.

The commerce with the country around the Lakes must be a great object though secondary to that of the West.—New-York will have the advantage of distance. Thence to

Buffalo being 523 miles, the distance thither from Philadelphia being about the same as from Baltimore, 535 miles, if we have the direct Canal, viz. 12 miles farther.

The superiority of Canals over rivers consists in the calculable regularity of the power which moves the navigation thereon; but when an equally regular moving power, as that of steam, can be applied, the ascent is effected with certainty and greater speed than Canals admit of. Rivers are thus converted into Canals, and subserve the purpose of transportation upward, as well as on the current downward. The laborious operation of *setting* boats up the stream will in due time give place on the Susquehanna and its branches to a suitable modification of the Steam-boat, calculated for a stern impulse in order to pass through locks, and impel two Canal boats, one on each side. A method which practice has abundantly tested on the southern rivers. The Juniatta—the West Branch, and the Main Stream are as capable of this mode of navigation as the Ohio, whenever the activity of business shall require and warrant this aid, and some of the rapids be improved by Locks.

That, however, can alone be the proper method of improving the ascending passage which does not interfere with the descending of rafts and arks.

The Lock described in the Appendix is adapted to this purpose. Besides its durability, it may be built on the shore—tight and strong, launched, floated and placed between walls where it is to operate. Much of the inland navigation from Boston consists of *submerged Locks*, of which the annexed extract may be surely considered a good testimonial.

This method is consistent with the caution given to civil engineers by the Chevalier de Buat, whose researches have

thrown so much light upon the laws which govern the declination and velocity of rivers, which re-assert their natural rights when too presumptuously invaded.

In discussing the policy of public works something may with propriety be said of the *financial* system adapted to them, though obvious to every considerate mind. Of course whenever the object is beyond the associate means of a corporate body, there is no power but that of government equal to the occasion. The utility of Canals may be so great as to induce a wise and provident legislature to execute them for the common good; but there are evident advantages gained by inducing private capital to join in effectuating them. If the state is part owner, there is a *certainty of completing* an undertaking, whose value depends on completion. At the same time the government has the aid and co-operation of an interested vigilance and care, in the construction; and in the subsequent good management of the Canal, on which profitableness will in a great measure depend.

The investment by the state may be considered invariably safe, if the *régime* was but duly regarded—business will have been ascertained to exist—the expense will be proportionate—the terms, rates or tolls being in the power of the Legislature, may be made such as to render the stock a sure investment. And should there occur any other and equally useful occasion, or object, for the application of the same fund, or to pay off any public debt, the stock is then saleable.

The terms of a charter for the making of a Canal, ought to be as liberal and favourable to private Stockholders as the prudence of a legislature would require in taking a part therein. If the grant is not worthy of this confidence on the part of the state, it cannot be worth the money of prudent men. If it is a work desirable and beneficial to the state,

it must be good policy to give adequate encouragement to men of capital to join in supplying the funds. When there exist objects of investment near home, money will not be sent into other states to be invested. It is always desirable to place property within view and subject to the owner's care. If a great work should be carried on by the State alone there are some districts which may derive no benefit from it, yet bear a part of the burthen. But if it is made a good property by the financial terms and productiveness of the investment, such portion of the people can have no reason to complain, because the Revenue enriches the treasury.

Our central Canals uniting the east to the west must become very profitable. Those of New York and Pennsylvania especially, may ultimately relieve the state from all taxes by their productiveness. Some Canals in England have risen ten hundred per cent.

There is reason to believe the Canal of Pennsylvania would be the most productive in the United States, because the large proportion of free navigation would make it the cheapest route. It is in the line of the greatest internal commerce. —It not only connects directly the greatest manufacturing city on the western waters with the richest commercial city on the Atlantic, but by this route it will be ultimately nearer from the city of New-York to the Ohio than by any other, viz.

To Brunswick .... 40 miles—by tide.
To Trenton ..... 30 miles—by canal.
To Philadelphia .. 30 miles—by tide.
To Pittsburg.... 370 miles—by canals and rivers.

Thus from New-York to Pittsburg is 470 miles by water through Philadelphia, instead of 790 by Lake Erie.

The nearest route from the Ohio to all the Eastern States may be through Philadelphia, if a Canal is made across the city as proposed or contemplated to facilitate the distribution and shipment of Coal, and for other purposes of business, following the old canal line and continuing it direct to the Delaware a little north of Callowhill street; also through the middle of Broad street till it can turn in the direction of the Navy Yard.

The necessity of supplying such a Canal principally from the Schuylkill, by means of the Fair Mount Water Works, in sufficient quantity for Lockage, would be an objection almost insurmountable. But as it will be found on due investigation, that the Lift may supersede Locks wherever water is to be saved, the power to raise one hundreth part of what Locks would consume, may well be afforded or spared.

By knowing the dimensions, it would be of course easy to calculate how long it would take *one wheel* to fill it: And by knowing how much water is required for each transfer of a boat, by means of the Lift, how many might be passed through by that quantity.

It is stated in the last Report of the Watering Committee that one wheel rises 1,250,000 gallons in 24 hours, 80 feet. As the level of the Canal would be about 40 feet, we may presume that to this elevation it would raise at least 2,000,000 gallons. And as a Lift requires the use of 400 gallons, it follows that one wheel raises water enough for 5000 passages of a boat, or 2500 through the Canal; which is more than one Lift at each end would admit and deliver, if kept constantly at work, employing 5 minutes for each operation, which by locks would have required twenty minutes.

It is not easy to conceive of a better use of the surplus power of the Water works, than to fill a Canal, which may

be not only a great accommodation to the city, but a link in the chain of communication by water, between the harbor of New York and the Ohio. The commerce passing through it from both cities would yield probably a great revenue in proportion to the cost.

Whenever this Canal shall be made, no inconvenience from stagnant water need be apprehended if its bottom be *paved,* that it may from time to time be thoroughly cleansed ; a precaution which so busy a place as it must be, with a quay on each side, should of course perscribe.

The reasons favourable to a Canal through New Jersey are already not inconsiderable, but viewed in relation to this chain of works, they rise to a degree of urgency on all concerned, and point out the true policy of New Jersey.

In this event the rivalry of the two greatest cities will be lost in blended commerce, which must combine their capital in both markets to mutual benefit. They are sufficiently different in local circumstances to give each great advantages. These need not be enumerated, but we may say of Philadelphia that the healthiness which its noble supply of pure water seems to have secured. Its literary and scientific and monied institutions—its skilful mechanic industry, and probable communication by canals with the more southern inland waters, far more than compensate for the temporary interruption of the shipping in winter.

It cannot be doubted that *the policy of a government essentially paternal,* guided by those who cannot but see the reciprocal influences of prosperity on the several portions of the whole state—the identity of the interests of the country and the seaport, whose means of sustaining commerce react upon the value of every product of agriculture ; will assert the great privilege enjoyed in the relative local position of the Commonwealth.

APPENDIX.

Extract of a Letter from the owner of the Elk Forge to a gentleman in Philadelphia, in answer to inquiries.

Elk Forge, March 20, 1824.

SIR,—Our dam is 6 feet high and 102 feet long supposed area about 15 acres. If the dam was put on a more eligible situation near the head of the feeder and made 12 feet higher than the present dam, the length would be about 340 feet.—The area 45 to 50 acres.

Immediately above us there is a fall of 3 feet unoccupied—Then a flour mill of 10 feet fall—then 3 feet unoccupied.—Then a rolling mill and nail Factory with a fall of 14 feet—Then a rolling and slitting mill, nail factory, &c, with a fall of 14 feet—Then a flour mill, woolen factory, &c. These falls reach up the Creek about three and a half miles. For the next five miles I am unacquainted with all the seats on the Creek, but there are several occupied—There is Pleasant Garden Forge with a fall of 20 feet, and above the forge there are several paper mills.

The Creek heads in Pennsylvania about 18 miles above this place. From its source it passes through a hilly country. If the dams were raised it would not overflow any considerable quantity of land.

The fall at the forge is 17 feet. The wheels are breast 5 in number with a head of 5 to 5½, viz. 3 bellows wheels, the apperture through which the water passes 3 inches deep 3 feet long. 2 hammer-wheels—the gates 10 inches high and 3 feet long. For full work the bellows-wheels go 14 to 16 hours. Hammer-wheels about half that time. On account of the scarcity of water last season we lost about three weeks full work.

During nine months of the year there is a surplus. In July, August and September, for the last three years there has been a scarcity. Previous to 1820 I do not remember our wanting water 2 hours at a time. Full work was done in August.

(Signed) SAMUEL HAYES.

EXPLANATION OF THE PRINCIPLES

OF THE

COMPOSITE LOCK,

Referred to in a Report, relatiue to the proposed Hudson and Delaware Canal from Kingston to near Milford.

The object of the Composite Lock, is to use wood as the cheapest material, and yet so that it shall be *durable.* This is effected by excluding from the substance of the structure, the *causes* of decay, *air* and *water.* The means of doing it, are found in the following mechanical and chemical principles, using as materials thin boards, sheathing-paper, pitch and lime.

The manner of building affords the greatest strength, because the fibres of the wood cross each other in alternate layers, transverse and lengthwise; trenailed very firmly, as they are successively put together; and with intermediate tar'd paper; each succeeding surface being payed with pitch, after the seams are caulked. This separation of every piece of wood, from every other, prevents fermentation and rot between them; and if the work is well done, the structure must be impervious to water and air. Then as carbonaceous substances are of an imperishable nature, this wooden fabrick, by being penetrated and filled with tar, must by its efficacy remain sound, as long as this substance retains that property.

The use of a small proportion of lime, among the pitch, is to form a *Cement,* and neutralize any acid that may be in the wood.

This method has some analogy to the well known use of the Pyro-ligneous acid, in preserving provisions, now beginning to be applied to the timber in ships. Its efficacy is attributable to the anticeptic properties of the components of smoke (Vinegar and carbon). Smoke differs from tar principally in being *volatile*, instead of being concentrated. But Pitch, which is a more concentrated tar, is better for this purpose; because, besides penetrating the pores of the wood, it forms a defence of its surface. One of the late improvements in the British navy (by Mr. Seppings) among others, is to inject a ship's frame, or to fill the pores of the wood with tar.

The manner of building a *Composite Lock Chamber* is simply this: the pit being dug, rough walls will of course be necessary to sustain the ground: these will also sustain the lock laterally, and its upper end.

After bolting a cap-piece on the walls, having an under groove overhanging the space a few inches, and after flooring the space between the walls with a mass of small stones for the bottom of the chamber to rest on, the work is begun by lining the space, first with thin oak boards (as bending more easily) which reach from the under groove of the cap on one side, down the wall, across the bottom, and up the opposite wall to the groove on the other side, nailed to each cap. The seams being chinced with oakum and the whole surface payed, it is then covered with tarred paper. It is now ready to receive the first *lengthwise* layer of pine, to be trenailed or nailed through the paper to the first layer. This second course is next to be caulked and payed and papered, to receive the *second transverse* layer of oak, which is covered and completed in like manner; and the fourth course, or second lengthwise (if the last) is finished by caulking and graving. The *trenails* of the successive lamina all reach to the

first layer. They are made by machinery and compressed that they may expand and cohere more firmly after being driven.

But if the Lock is of uncommon depth, which this method of building permits, one or two courses more may be expedient. Two Locks of this kind may be made to lift as many feet perpendicularly, as *three* locks on the old and usual plan: thus saving one third of the locks of a Canal.

The outside surface only is exposed to the air; but as it is in contact with stone which keeps it cool, it will remain sound. The inside surface will be protected sufficiently by a renewal of its coat of pitch from time to time. The bottom being always under water will remain sound. The gate posts may be either of Wood, Stone or Cast Iron. Instead of culverts, horizontal pivot gates are used (as on Middlesex Canal;) placed above the upper pair of lock gates, which let the filling water descend into the lock chamber through the upper floor; the lower floor being protected from wearing by means of timbers, plank or stone.

The saving in the first cost of this kind of lock, compared with cemented walls is such, that were the difference put at *Interest* for the period of its duration, it would amount to many times more than the expense of replacing the Chamber eventually. It is therefore true economy. This manner of building is also well adapted to our country and climate; as the material abounds, and the frost sometimes heaves the walls of locks and destroys the cohesion of their cement: In England and France the winters are too mild for this effect.

Thus great durability is given to a wooden structure, and the lockage in river works made more practicable, and less costly. In this way may be also constructed the *aqueducts* of a canal.

P. S.—Mr. Annesley, the inventor of the New Naval Architecture now getting into use on the Canals of New-York and in ships of burthen in England, as well as in the construction of steam boats on Lake George like that built at Hull in England which run 12 miles an hour with ease—is also the inventor of Aqueducts and Bridges on the same principle of composition, whereby wood is not only put together with prodigious strength, but in a manner that makes the structure durable. This will be peculiarly applicable to long aqueducts both on account of the tightness of the work and its unalterableness from any external cause.

EXPLANATION OF THE PRINCIPLES

OF THE

PERPENDICULAR LIFT

Invented by Benjamin Dearborn of Boston:

Alluded to in a Report on the proposed Delaware & Hudson Canal.

In describing *this method,* it may be premised, that the inventions of Mr. Dearborn combined in this form, have rendered the *Perpendicular Lift,* or Moveable Lock, entirely *practicable*; the parts invented by him being essential to its efficient operation. It has not yet had an opportunity of being built on a large scale; though it operates perfectly well on a small one.

The Lift may be considered as a *time* and *water saving machine.* It consists of a building whose sides are either walls or columns; standing between the ends of two sections, or *pounds* of a Canal, of different levels, for the purpose of transferring boats from one to the other, which it may do easily if the difference of altitude does not exceed forty feet, or the usual lift of *five locks.*

The building contains the Transit, which has water enough within it to float a Canal Boat. It is suspended by chains, proceeding from its sides over pullies, (which are grooved cast iron wheels, fixed on iron shafts, supported on, or by, the columns or walls,) leading to weights of stone, capable of holding the Transit in equi-librio.

When the Transit is up, and the weights of course down, it is not in contact with the entrance into the Canal; but it is easily brought in contact by means of levers, which force it a little *end-wise,* to be joined thereto.

A single transverse gate closes the Canal, and another shuts in the water of the Transit. The *gate-frames* being brought in contact, the joint is made water-tight by *leathers* or by *felt* thereon.

The Gates open by descending into their respective receptacles; for which purpose, they are not hung on hinges, but suspended to weights. The Transit has a gate at each end in like manner.

When in the position to be joined to the upper pound, the water in the Canal pressing against its gate, and the water in the Transit also pressing against its gate, they cannot open unless the space between them be filled with water.

This is done through a small culvert. If the space is 10 feet wide and 3 feet deep, the quantity required is 30 cubic feet. The communication being opened the boat passes in or out; if inward, she displaces as much water as she weighs; if outwards as much water enters as she did displace by her bulk, the water from the Canal taking her place. The quantity of loading on board does not affect the equipoise of the Transit and weights. Yet in order to give preponderance to the Transit, a little more water is permitted to enter than it had in before : this is done by not allowing the Transit to rise so high but that the surface of the water in it, before the gates are opened, (which corresponded with the other level of the Canal) shall be a little lower than the surface of the upper level ; consequently on opening the communication, it receives in this difference, which gives it preponderance; indeed it would go down immediately were it not prevented by the levers, which press the transit to the entrance of the Canal, and other apparatus which sustains it there.

This *adjustment* depends on the use of connected ranges of wedges, upon which the weights rest when down : for by

moving them inward, they prevent the weights from descending so low as before; if one inch, the transit does not go up so high by one inch; and therefore receives an inch more in depth of water: or on the contrary, if the weights are allowed to descend lower, the Transit goes higher and receives less water; as the variation of the surface of the canal from wind or other causes may prescribe.

For the like purposes, when the transit is down, there are two ranges of wedges under its sills, to adjust it to the lower level. Water being then let in between the gates, the boat passes out, together with the preponderating water received from the upper level. The preponderance now returns to the weights which are up and the transit would instantly rise if released.

The water used between the lower gates passes into a cistern; and that portion used between the upper gates falls into a *receiver*; which by the force of the weight of this water, works a pump, which returns the water, from the cistern to the lower pound of the Canal; and at the end of each stroke, or descent of the receiver, a valve opens in the bottom thereof, and allows its contents also to flow into the lower level.

The lift is thus operated by the transfer of thirty cubic feet of water from the upper to the lower pound, together with that portion which gave the preponderance. Thus one inch over a surface of 70 feet by 10 feet, is 58 cubic feet, or 3625 lbs.; but as one-fourth of this weight may be sufficient, 15 or even 20 cubic feet may be added to the 30 used between the gates; thus 50 feet bears the proportion to the quantity required for one lock, that 50 does to 5600. So that a lift requires $\frac{1}{110}$th or saves $\frac{99}{110}$ths of the lockage water of a Canal. But the *upward* passage requires only the 30 feet, which is again returned to the Canal by the pump. And it is obvious that if

the descending trade is greatest, water will be transferred to the summit. An empty boat would go up with water enough to bring down an hundred loaded ones.

The weights will be conveniently made of split stone, of which 14 cubic feet make a ton.

The chains are of any requisite size. Coming within the known rules of calculation, and being previously *proved*, they are sure to be strong enough: inch iron will suspend 60,000 pounds, or 27 tons. Chain Cables are tested to the extent of 18 tons per inch.

To suspend a boat of 25 tons with the water, in which she floats, which together with the counterpoise is about 60 tons, four chain cables of one inch iron would be sufficient; or 16 chains of half inch iron. But in practice, the additional expense of ¾ inch iron, would give 125 per cent more strength to the chains than is theoretically requisite.

The load, whatever it be, necessarily distributes itself over the whole foundation, upon every pillar, to every chain, and with a steady pressure.

The controul or management of the Transit, is principally by levers, which are established in the roof with other apparatus, not necessary now to describe; nor the manner of *compensation* for the transfer of the chains over the pullies.

Situations for Lifts, should of course be chosen, so as conveniently to back the wall which terminates the upper level, by the earth excavated from it; and so that any excavation for its foundation, will be applicable to the nearest embankment.

This improvement will be applicable to elevated districts of country, and to Canals conducted along vallies, where there

are mills; when, instead of taking the whole water from them, it borrows only enough for the operation of the Lifts, so small a quantity as scarcely to be a damage. For example, the upper mill pond of a stream, would in the spring, by its redundant water fill the Canal; which would then leave almost the usual quantity to follow its natural course; thus saving the proprietors a heavy expense, and the neighbourhood of the Canal from the inconvenience of an interruption of a productive branch of business. J. L. S.

Extract from the Records of Middlesex Canal, of January 30, 1824, referred to in the topick of Submerged Locks.

"That John L. Sullivan, during the ten years he was in the general agency of the Corporation, having authority to construct eleven distinct works, forming a communication by water from Boston to Concord, which was fully effected by Canals, in some places along the falls and establishing locks *in the river itself.*—That the works so erected were well constructed, and are still fully sufficient for the purpose intended.—That the records of the Board of Directors shew, that several special committees fully approved of the *manner* in which the services had been performed.

Signed by Aaron Dexter, President.

Extract from the Report of Benjamin Wright, Esq. on the Hudson and Delaware Canal, to Messrs. Maurice and William Wurts.

"You will see by the Report of Mr. Sullivan, several different ways of lifting or letting down boats with loads from one level to another. Some of these plans are proposed to be executed in part with wood. Although strong prejudices exist in the minds of many persons to the use of wood in works of this kind, on account of their being subject to decay, I can with great confidence assure you, that in my opinion, it is right and proper, and good economy to use wood, when applied to our country and to individual enterprise, for the ways and means to accomplish these internal improvements."

"Wherever wood used in the construction of works of this kind (in part) produces a great saving in the expense, and can be renewed at a time when it does not interrupt the navigation, it certainly is good economy. And by the use of this material, if we save 50 *per cent.* of the capital to be employed, and can make repairs easily and cheaply, it always enables the stockholders to have a fair and perfect demonstration of their prospects of profit, and thereby enables them to enlarge, or make more permanent their works, as shall appear proper upon practical knowledge of the profit."

"The great objection to the use of wood in works of this nature, in our country, has arisen as I apprehend, from the fact, that no attention has been paid to the rules I have laid down above: *namely, to so use it in the construction of your works as that it can be easily replaced with new at all times, without interrupting the navigation.* When this plain rule is lost sight of, then it becomes an improper substance for great and important works."

"Before I close, it may be proper to say something in regard to the manner of building locks of wood, as suggested by Mr. Sullivan, which he has fully explained to me; and I can freely say I think it practicable, and should the work be executed in the manner he has verbally described to me, the project is deserving of patronage, if it can be so done as to unite substances by which great preservation and consequent durability is given to the wood. It is certainly well adapted to our climate and country."

Extracts from General Harper's Speech to the citizens of Baltimore, assembled to deliberate on the proposed Canals.

"The state of Ohio will also be united with you, in the closest commercial connection. Its rich commerce will be poured into your lap. Her whole population is free and amounts to 581,434 souls. This great population so rapidly increasing, does not fill up one third of her territory, which contains 39,000 square miles or 24,960,000 acres, and is well known to be distinguished for its fertility.

The same may be said of a very large part of Kentucky—all that part which lies above the falls of Ohio, and contains a population of 287,236 souls. So also of Indiana, together a population of more than 1,500,000 persons.

Baltimore is nearer than New Orleans to almost the whole of Kentucky and every part of Indiana and Ohio:

From here to Pittsburg by the proposed Canal, would be 350 miles.

From Pittsburg to Cincinnati, is about 500 miles by the river.

From Cincinnati to the Falls of Ohio at Louisville, the distance is about 200 miles by the river.

Thus from Baltimore to Louisville is about 1000 miles.

From Louisville to the mouth of the Wabash at the south western extremity of Indiana, is about 200 miles.

From New Orleans to Pittsburg is 2200 miles—to Baltimore 350
From N. Orleans to Cincinnati is 1700 miles—to Baltimore 850
From N. Orleans to Louisville is 1500 miles—to Baltimore 1000

"To form an adequate notion of the commerce which would then be secured to Baltimore, you must reflect on the vast extent of these inland seas, (the Lakes) the countries bordering on which would be rendered maratime for your benefit. We may state the length of Michigan at 300 miles and its breadth at 50, which gives a circumference of about 700 miles. Lake Huron is estimated at 220 miles with a mean or average breadth of 90, which gives about 620 for its circumference. Lake St. Clair has a circumference of abont 90 miles. Erie is about 240 miles long with a mean breadth of about 45, which gives about 550 for the extent of its coast, making a total of more than 1700 miles of coast, which this communication would connect with your port, by the shortest, safest, and most convenient communication which it can have with the Atlantic. Reflect on the vast tracts of fertile land, which lie contiguous to these shores; on the countless multitudes by whom they will hereafter be inhabited and cultivated; on the immense commerce to which this cultivation and the corresponding consumption must give existence; and you will then be in a condition to form some idea, faint indeed and inadequate, of the importance of the work which is now recommended to your favour and patronage.

But when to this mighty mass you add the trade of the Ohio and its branches, the mind is confounded by the immensity of the prospect, and even the imagination fails in the attempt to embrace it.

If we take the shores of Michigan and St. Clair and Huron, with half of those of Erie at 1700 miles, and extend 50 miles back from them in every direction we shall embrace an extent of

	84,000	square miles,
equal to acres, - - -		54,400,000
So also if we take the distance from Pittsburg, to the Louisville Falls of the Ohio at 700 miles along the river, this gives 1400 miles for the length of the two shores; and an extent of 50 miles from the river on each side would embrace, *sq. miles.* -	70,000	
or acres, - - -		44,800,000
In the same manner 200 miles to the Wabash, and 150 its navigable length,	32,500	
		22,800,000
Square miles,	186,500	
Acres. - - -		122,000,000

What is there, I will not say on the Susquehanna, I will not say in the United States, but in the world, to compare with this prospect? What commercial city possesses sach facilities and extent of internal communication as this undertaking promises to Baltimore?

The resolutions offered and advocated by Gen. Harper expressed a preference for the Potomac route; but the resolutions offered by Gen. Winchester, were adopted, a part of which were in these terms:

Resolved, That we consider the Susquehanna Canal as reported by the Commissioners capable of being accomplished, and that in the opinion of this meeting it is entitled to and ought to receive their unanimous and undivided support, &c.

TUNNELS.

In making *Tunnels* it is usual to precede that work with *headings* which are carried into the hill parallel, and a few feet below the inverted arch of the Tunnel for the purpose of carrying off the water. These in England cost about $10 per yard run.

The Tunnel of Blisworth on the *Grand* Junction Canal is stated to be of the following dimensions: Internal width 16½ feet.—Depth below the water line to the inverted arch 7 feet—and the crown of the arch 11 feet above the water line. The side walls are segments of circles of 20 feet radius—the top arch of 8 feet radius. The side of the top walls 19 inches thick—the bottom 13 inches. This Tunnel was built at about 71 dollars a yard run: Others cost above 106 dollars a yard (£24 sterling.)

In a note of Mr. Shrivers' late publication, it appears to have been stated by one of the members of the Canal Convention.—That Brindley's Tunnel on the Trent and Mersey cost £3,10,8 per yard (15 dollars.) That a Tunnel on the Thames and Severn Canal cost 8 guineas (37½ dollars) per yard. And that Tunnels now cost (for labour only) from 3 to 7 guineas per running yard.

We have thus given the extremes of experience in England. The cost in the United States will be augmented a little by being in an elevated and unsettled part of the country.

The expense appears to depend on the nature of the ground as well as the size of the Tunnel. In some iustances in England they are wide enough to allow of *tow paths*—in others the boats are shoved through with poles, or lying down on the deck (sufficiently raised) the men shove with their feet against the arch.

It will be a better way to hang chains along the sides by which to pull the boat forward.

Should a Tunnel be formed through the Alleghany—and the width sufficient only for one boat—the passage must be made each way alternate hours, by all that arrive in the preceding hour.

NOTE.

Page 9—line 26, read "reach Baltimore."
13 " 9, read "3,200 hogsheads."
18 " 26, read "yards."
24 " 8, read "distances."
19 " 29, read "5f. 10.

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